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Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER & SYSTEMS COMPANIES — WORLDWIDE

AUGUST 20, 1990

JAPAN'S SLOWED HDTV STRATEGY

U.S., Europe vow to set standards

PAGE 30

Masao Sugimoto, director general, NHK science and technical research laboratories

Who's cutting capital spending?

PAGE 24

Lucky-Goldstar's biggest mistake

PAGE 67

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES—WORLDWIDE

VOL. 16, NO. 16 AUGUST 20, 1990

PAGE 30 Japan's Broadcasting Corp.'s Masao Sugimoto: Frustration for an HDTV pioneer

COVER STORY/HDTV

30 Japan is ready for HDTV, but the rest of the world isn't

With an impressive technological lead, the Japan Broadcasting Corp. made no secret of its plan to make its Hi-Vision system the global standard for high-definition television. But regulatory delays put those plans on hold, and American and European companies are racing to establish their own HDTV standards.

UPDATE

11 Business Trends
The high cost of no-lead legislation; DoD's Craig Fields joins MCC; Solectron CEO cited; the world's fastest computer looks for a market; Koreans argue for technology transfer; Ultratech wins its independence; DEC embraces client-server computing; ad campaign aims at high-tech Walter Mitty.

21 Economic Trends
The U.S. is destined to become the technology laggard in the new world order, according to a recent report from the U.S. Department of Commerce.

23 Companies to watch
Digicom Systems uses customized DSP chips to make modems smarter; Velox Computer Technology chills chips for faster processing; Digital Data Systems makes fax modems for whole local area networks.

UPDATE

27 Commentary
U.S. Rep. Edward J. Markey says the U.S. telecommunications industry has a golden opportunity to dismantle the "sonic wall" that still keeps Eastern Europeans from their free-market potential.

COVER STORY/HDTV

30 Japan is ready for HDTV, but the rest of the world isn't
It isn't hard to find the motivation behind the battle to set the standard for high-definition television. The consumer HDTV market alone is expected to reach $2.6 billion worldwide by the year 2000. Combined with related systems, the market could reach $39.6 billion.

38 U.S. struggles to establish HDTV agenda
High-definition television will affect U.S. companies in several sectors, from television production to components. But how to tackle this new global market? Debate rages in Congress, in the boardroom and in the press.

COVER STORY/HDTV

44 Europe's 1995 HDTV goal: A standard of its own
European companies have fought off the imposition of a Japanese standard for high-definition television. Now, a group of more than 40 companies have launched an ambitious project called Eureka to introduce European HDTV programming and hardware by 1995.

STRATEGIES

49 Bose: Building a sound marketing strategy
Long years of research have allowed Bose Corp. to move from the consumer loudspeaker market into automobile sound systems, television and even computers. And Bose is growing in a market that generally has been flat.

MANAGING RESOURCES

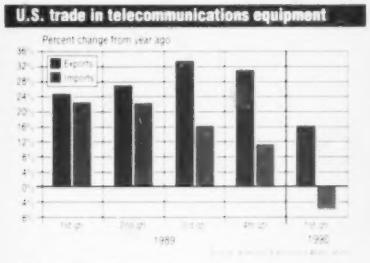
54 The squeeze is on in capital spending
The slowdown in industrial activity late last year has made U.S. companies very choosy about investing in capital equipment. The rate of increase in spending slowed in 1989, and many experts see little or no increase this year.

PAGE 11 NEC announces world's fastest computer

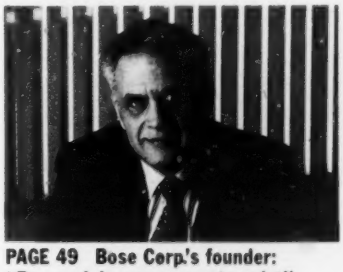
PAGE 30 HDTV producer Barry Rebo: "People don't know if there's going to be an HDTV industry"

PAGE 38 Planar Systems' Jim Hurd: HDTV has sparked flat-panel R&D

PAGE 60 From Britain to Leningrad: PCs at a profit



PAGE 86 U.S. telecom exports growing



PAGE 49 Bose Corp.'s founder: "Research is our reason to exist"

EUROPE BUSINESS

60 Can ICL make money selling computers to the Soviets?
Joint ventures in the Soviet Union are risky. British computer company ICL, now 80% owned by Fujitsu Ltd., has an advantage: A large Soviet partner that can pull some strings.

65 EC directive opens door to reverse engineering
Proposed European Commission directives could break new ground in determining how European software and database markets can be protected from piracy.

ASIA/PACIFIC BUSINESS

67 Ailing Goldstar needs strong medicine
South Korea's ambitious electronics industry is beset by problems: poor product quality, slowing market growth and difficulty using new technology. All those problems are reflected in the experience of $22 billion electronics giant Lucky-Goldstar.

MARKET PERSPECTIVES

74 Auto electronics companies find safety net for sales
North American automobile sales are slumping, but the electronic content of each car sold keeps growing, from an average of $515 in 1989 to an estimated average of $1,100 in 1994. Anti-lock braking systems and other safety features get a lot of the credit.

77 Boom days are ahead for programmable logic
In their haste to get products to market, PC, workstation and peripherals markets are shelling out big money for sophisticated programmable logic devices. Small PLD companies are thriving now, but may need to grow or partner as the bigger fish move into the market.

BUSINESS BAROMETER

86 Communications
Because new orders for telecommunications and data communications equipment are climbing at double-digit rates, expect shipments to continue their steady advance.

87 Defense
Defense cutbacks hit hard overall, but defense purchases of electronics grew 28.8% in the first quarter of 1990.

DEPARTMENTS

7 **Inside Business**
83 **My View**
About tears, hugging and being fair
84 **Advertiser index**
88 **Viewpoint**
Don't say sayonara to the world computer marketplace

COMPANIES IN THIS ISSUE

80 **An index of the companies covered in this issue.**

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Total Circulation: 77,804

REPRINTS

ELECTRONIC BUSINESS articles are available on a custom printing basis at reasonable prices. Contact Andrea Marwitz, Cahners Reprint Service, Cahners Plaza, 1350 E. Touhy Ave., PO. Box 5080, Des Plaines, Ill. 60018 (708) 635-8800. Electronic Business can be purchased on 35mm microfilm through University Microfilm Int. Periodical Entry Dept., 300 Zeeb Road, Ann Arbor, Mich. 48106.

Keeping the copy flowing

As anyone who ever got close to the smell of grease paint knows, back stage players are just as crucial to the performance as lead actors. Electronic Business is no exception. The writers might get the bylines but it's the detail-oriented workaholic editors and production staff that keep them honest.

This issue we introduce two new behind-the-scenes faces to our readers: John Parker, section editor, and Maura Baker, assistant production editor. While John and Maura have been with us for less than two months, both have already become invaluable resources. They keep the copy flowing, make sure the i's are dotted and the t's are crossed and check that pie charts add up to 100%.

Although you'd never guess it from this picture, John brings a full 20 years of business journalism experience to Electronic Business. His past employers include PC-Week, Lightwave Journal and two well-respected New England daily newspapers. Maura comes via a corporate graphic arts background and a recent magna cum laude degree from Curry College, Boston. Welcome to you both.

Section editor John Parker, and Assistant production editor Maura Baker

HDTV: The real story

Both John and Maura were integrally involved in this issue's HDTV special report, coordinating the copy and charts as they came in from our editors in Japan, Europe and the U.S. Says John, "It was technically challenging working on an issue that is unfolding as we speak."

Challenging is the operative word here. Making the politics of HDTV intelligible is no easy task, especially as the saga of conflicting standards and emerging technologies is unraveling simultaneously on two continents and in Japan. To get the big picture meant a two week trip to Tokyo for assistant editor Peter Burrows and some continental travel for London-based senior editor Barbara Berkman. Contributing editor Dwight Davis covered HDTV in the U.S.

The resulting stories make compelling reading. Peter tells of a Japan confronting a world unwilling to adopt its HDTV standards as the official global standards. Instead of pressuring the White House or the EC's Brussels headquarters, the Japanese will do battle the marketplace.

But that's only half of the story. Peter writes that the Japanese are also targeting non-consumer applications for high definition technology, applications that will deeply impact the global electronics industry.

BRUCE RAYNER, senior editor

ELECTRONIC BUSINESS (ISSN 0163-6197) is published twice a month, except monthly in December, by The Cahners Publishing Company, A Division of Reed Publishing USA, 275 Washington Street, Newton, MA 02158-1630. Terrence M. McDermott, President; Frank Sibley, Senior Vice President/General Manager, Boston Division; Jerry D. Neth, Senior Vice President/Publishing Operations; J.J. Walsh, Senior Vice President/Finance; Thomas J. Dellamaria, Senior Vice President/Production and Manufacturing; Ralph Knupp, Vice President/Human Resources. Circulation records are maintained at Cahners Publishing Company, 44 Cook Street, Denver, CO 80206-5800. Telephone: (303) 388-4511. Second-class postage paid at Denver, CO 80206-5800 and additional mailing offices. POSTMASTER: Send address corrections to ELECTRONIC BUSINESS, 44 Cook Street, Denver, CO 80206-5800. ELECTRONIC BUSINESS copyright 1990 by Reed Publishing USA. Ronald G. Segel, Chairman and Chief Executive Officer; Robert L. Krakoff, President and Chief Operating Officer; William M. Platt, Senior Vice President. Annual subscription rates for non-qualified people: USA $79.95; Canada, C $99.95; other countries, $120 per year; $100 air mail surcharge. Except for special issues where price changes are indicated, single copies of regular issues are available for $10.00 (USA, Canada/Mexico and foreign). Please address all subscription mail to Eric Schmierer, 44 Cook Street, Denver, CO 80206-5800. Cahners Publishing Company, A Division of Reed Publishing USA • Specialized Business Magazines for Building & Construction • Research • Technology • Electronics • Computing • Printing • Publishing • Health Care • Foodservice • Packaging • Environmental Engineering • Manufacturing • Entertainment • Home Furnishings • Interior Design. Specialized Consumer Magazines for Child Care • Boating • Wedding Planning.

BPA ABP

Bose: Building a sound marketing strategy

With a methodical R&D strategy, the $300 million privately held speaker maker is moving into new markets: TVs, airplanes and a surprise expected soon

BY BARBARA JORGENSEN

A sunlit foyer at Bose Corp. in Framingham, Mass., displays component speakers — some 3 feet tall, some that can fit in the palm of a hand — the way other corporations decorate with potted plants. A longtime niche player in the consumer high-end loudspeaker market, the 26-year-old company is using its acoustic technology as a base from which to broaden its product line.

Behind the products is a commitment to technology, time, investment and innovation that Bose believes few companies can match. In founder Amar G. Bose's words: "Research is our reason to exist."

Besides being chairman and technical director of the company, Bose is also a professor of electrical engineering at the Massachusetts Institute of Technology in Cambridge, Mass.

Adapting this research to a variety of products requiring audio, the speaker manufacturer has made inroads into the automobile sound system and television markets. Additionally, one Bose product, called the RoomMate, is sold as an add-on for the Apple II GS.

Bose claims to reinvest 100% of profits in research and development to finance growth. Despite repeated recommendations to go public, according to managers, Amar Bose has steadfastly kept his company private. Audio technology developers need time — years sometimes — to create products that will make a real impact on the market, without having to worry about the next quarterly report, he says. The company's primary strategy has been to apply the technological principles that grew out of years of research to new markets.

In 1989 the privately held company reported worldwide sales of about $300 million — a conservative figure, according to Nic A.M. Merks, general manager for the component audio division. An estimated half of Bose's sales come from overseas. Bose claims to have the best-selling component speaker in Japan, as well as in Canada, Spain, France, the Netherlands and Australia. While analysts are hesitant to confirm that claim — competitor JBL International, Northridge, Calif., a division of Harman International Industries Inc., claims it ties for the No. 1 slot in Japan — they will say the two U.S. companies are decidedly the top competitors.

$400 million sales goal

The company's goal for 1990 is $400 million in sales, Merks says. If achieved, Bose will have grown 30% in a market that has been relatively flat, according to Anindya Bose, a vice president of market research firm LINK Resources Corp. in New York City and no relation to the speaker manufacturer.

Bose's founder Amar G. Bose: "Research is our reason to exist"

The company did not reach its growth rate on component speakers alone. In a consumer electronics environment not noted for its marketing, says Marc Finer, director of Pittsburgh-based Communication Research Inc., Bose's marketing has set it apart. "Bose has anticipated changes in the marketplace and has acted on them," says Finer. "It innovates and changes market direction."

Bose's first breakthrough in acoustics was the 901 direct/reflecting loudspeaker — a project that took a dozen years to complete. It was developed essentially in response to what Amar Bose, as a recent graduate and newly appointed professor at the MIT, had seen as inadequate measurement of human perception of sound. Through the study of psychoacoustics — the relationship between human perception of sound as opposed to sound measured electronically — he found most sound from a live performance reaching the listener was reflected off surrounding walls, ceilings and floors.

Unlike conventional speakers, the 901, released in 1968, does not aim sound directly at the listener. Instead, it projects selected signals through the front grille and reflects the rest off the back of the speakers. Specialty magazines credited this approach with revolutionizing sound reproduction for the home, and the 901 still sells briskly today.

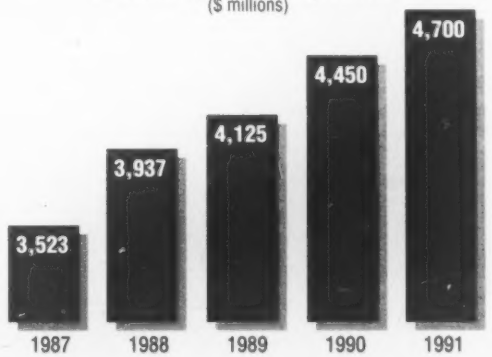
The same philosophy that drove Amar Bose to research the dynamics of sound reproduction in the home led him to examine the acoustics of the automobile. In the late 1970s, he recognized that sales were sluggish for cars with factory-installed sound systems. Instead, buyers were install-

ing more sophisticated after-market systems made in Europe or Japan.

Until then, the interior of a car was considered a sound wave nightmare of padding, glass and plastic. Amar Bose figured psychoacoustics and a music system fitted to the exact configurations of a specific car model might overcome the obstacles and, as a result, give him more control over how sound reached the driver. "I thought I could actually create better sound in a car than in a room," according to Bose. "We can control where the sound goes in a car." Where a sound system gets placed in a room is a decision to be made entirely by the consumer.

Bose rides growing autosound market

Total autosound equipment — excluding foreign-installed autosound equipment in imported cars
($ millions)



Half of Bose equipment is installed domestically

Source: Electronics Industries Association

Bose set about creating the market for high-end auto sound systems. Through an MIT colleague, Bose approached General Motors Corp. in 1979. According to marketing planning manager for Bose's original equipment manufacturer (OEM) division Robert Luppino, the deal between Bose and GM's Delco Electronics division was completed on a handshake.

"[In the auto sound market] Bose anticipated the after market would be declining, and it put itself right upfront," Finer notes. "It was first in that market with GM." Some time after the Delco/Bose deal was cut, Ford Motor Co. and Chrysler Corp. began to market their cars with systems from Harman. Fords now sport JBL systems, and Chrysler is carrying Infinity systems.

Luppino says Bose didn't see its first dollar from its auto endeavors for three years. Bose's financial commitment to the project is estimated at $13 million. Since its initial deal with GM, Bose has also formed partnerships with other automakers, including Honda, Acura, Nissan, Infiniti and Audi — another marketing first, says Finer. "It was first to go to the Japanese and establish partnerships with companies that U.S. companies were afraid to approach."

"We'd still be doing business only with GM if it could sustain the level of business we want to achieve," says Luppino. Bose's OEM business has doubled over the past 18 months, he says. Bose's OEM division, dealing mainly with automakers, accounts for about 20% of Bose's sales.

Another research project led to the technology that enabled Bose to equip television sets with full stereo sound. Bose engineers spent 15 years tackling the problem of reproducing bass notes without the hefty cones of conventional speakers. The result: Bose's patented acoustic waveguide technology, a folded resonating tube that imitates bass notes much like a pipe organ or flute.

Bose committed $14 million to develop a mathematical formula to duplicate this effect. The resulting technology was introduced in 1984 in a product called the Acoustic Wave Music System. It's a portable full stereo system measuring about one cubic foot — similar to a boom box.

"The idea of portable stereo systems was not new," says Finer. "But Bose took the technology into new designs and took them straight to the customer — and to Zenith." Rather than selling the Acoustic Wave through retail channels, Bose markets the system door-to-door.

Around 1985, Amar Bose began noticing the increasing use of stereo sound in television. "When we came out with the Acoustic Wave, we thought we could add excitement to television viewing," he says. Bose signed on with Zenith Electronics Corp. — the last major television company still manufacturing in the United States — and its chief executive Jerry Pearlman. In January, Bose signed its second five-year contract with Zenith.

Bose was able to adapt the lengthy Acoustic Wave tube for Zenith sets, adding at most an inch to the size. Bose's Waveguide sound system is marketed in the Zenith Digital System 3 line of products.

Bruce Huber, Zenith vice president for marketing for consumer products, says the Zenith/Bose products have been "remarkably successful."

"It's been a perfect marriage in terms of our strategy in satisfying consumer needs these days," according to Huber. "People want to maximize the viewing experience, and the high-performance sound has been a 10-strike." Huber also notes that studies have indicated the relatively higher price point of these sets has not inhibited consumer spending on them and that brand loyalty has worked in both companies' favor.

From sonics to silence

Bose's most recent product has less to do with sound than usual — it's designed to cancel it. A noise reduction headset was developed as a result of Amar Bose's observation in 1979 that background noise in airplanes interferes with passengers' listening to recorded music or movie tracks. The headgear is designed to cancel unwanted background noise while enabling radio signals to get through to pilots.

In a high-visibility marketing move, Bose Corp. donated a pair to the historic around-the-world Voyager flight in 1986, and the headsets were used by pilots Dick Rutan and Jeana Yeager to prevent possible hearing loss.

In five years, Amar Bose says, he'd like his company broadening into more than audio systems. "We can afford to do research in anything, but we are gearing primarily toward the consumer," he says. Bose will not be specific about new products, but hints there will be a product announcement soon: "Very high tech — and it will have nothing to do with sound." □

The squeeze is on for capital spending

Capital spending at the top 100 electronics companies barely increased at all last year. Exclude top spender IBM, and total spending by the top 99 actually fell

BY BRUCE C.P. RAYNER AND LINDA STALLMANN

The electronics industry's top capital equipment spenders invested more in plants and equipment in 1989 than they did in 1988, but the rate of increase slowed significantly.

The top 100 capital spenders among publicly held U.S. electronics companies spent a total of $18.9 billion last year, up 3.3% from 1988. But because of the slowdown in industry activity late last year and in early 1990, many pundits believe the prospects for continued increases in capital spending are poor for 1990.

"With continued pressure on margins and the nasty cyclicity in the industry, people are more careful about where they put their money," insists Russel Craig, vice president and leader of the electronics, information and telecommunications practice at Arthur D. Little Inc. in Cambridge, Mass. Areas of growth will be electronic design automation (EDA), computer-aided software engineering and other productivity enhancing equipment, he predicts.

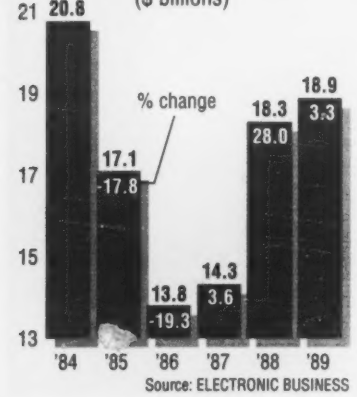
Last year, IBM topped the capital equipment spenders list by shelling out $6.4 billion for plant, machine rental and other property. That figure is up 19% from 1988 levels. IBM spent more than second-ranked Digital Equipment Corp. by a factor of almost five and accounts for more than one-third of the total capital spending by the top 100 companies.

IBM has been on a rejuvenation kick in an attempt to improve inter-

Top U.S. capital spenders by segment

On the up but slowing

Capital spending by the top 100 electronics industry spenders ($ billions)



Source: ELECTRONIC BUSINESS

Capital expenditures FY 1989	Total ($ millions)	Change from 1988
Components		
AMP	$252.1	14.5%
Molex	93.9	36.7%
General Instrument	82.6	37.7%
Burr-Brown	28.0	31.6%
Sprague Technologies	27.7	-27.3%
Vishay Intertechnology	23.8	68.4%
Augat	18.0	1.9%
CTS	10.8	8.4%
Total	**$537.0**	
Weighted average		**19.3%**
Medical		
Medtronic	$51.3	53.3%
Beckman Instruments	50.5	13.0%
Westmark International	14.0	24.5%
Diasonics	9.3	-11.4%
Total	**$125.2**	
Weighted average		**25.2%**
Office equipment		
Xerox	$436.0	-14.2%
Pitney Bowes	299.7	-3.2%
Smith Corona	17.9	102.2%
Total	**$753.6**	
Weighted average		**-8.8%**
Computer-based systems		
Perkin-Elmer	$56.6	-32.3%
Measurex	25.0	143.6%
Symbol Technologies	14.1	-7.4%
Intermec	11.7	197.6%
Gerber Scientific	10.3	-33.3%
Diebold	9.9	21.5%
Total	**$127.6**	
Weighted average		**-6.6%**
Consumer		
Tandy	$122.5	30.1%
Zenith Electronics	34.1	3.6%
Total	**$156.6**	
Weighted average		**23.2%**
Communications		
Motorola	$1,094.0	25.3%
General Instrument	82.6	37.7%
DSC Communications	50.5	10.1%
3Com	23.7	25.4%
Andrew	16.3	26.7%
Dynatech	15.9	5.2%
Datapoint	15.8	-19.8%
Scientific-Atlanta	15.6	54.1%
Tellabs	14.3	29.4%
ADC Telecommunications	9.6	-28.9%
Network Equipment	9.4	100.1%
Total	**$1,347.6**	
Weighted average		**24.2%**

Source: ELECTRONIC BUSINESS

nal productivity. During the past five years, the company invested approximately $24 billion in land, building and capital equipment. That represents 54% of the gross asset value of plant and other property, according to company reports.

Such a spending spree distorts the underlying trend for the rest of the industry. If IBM is removed from the list, total capital spending for the other 99 companies shrank last year by 3% to $12.5 billion.

In total, 31 companies cut capital spending last year compared with 23 companies in 1988. Contributing to the contraction was DEC, which cut capital spending $300 million.

The biggest capital spending cuts in percentage terms came from Micropolis Corp. The maker of disk drives watched its sales plummet 13% and net losses balloon to almost $50 million. As a result, its capital spending dropped by 79.9% to $12.8 million, lowering Micropolis from 36th place on 1988's list to 85th place last year. Other big cutters include: Ashton-Tate Corp. (No. 70), Concurrent Computer Corp. (No. 86) and The Ultimate Corp. (No. 99).

At the other end of the scale were companies like Micron Technology Inc. (No. 20), the fastest-growing capital spender for the second straight year. The dynamic RAM maker increased its capital spending last year by 349.6% to $199 million largely as a result of bringing a new 177,406 square-foot semiconductor fabrication facility on line.

Big spending boosts also came from Everex Systems Inc. (No. 84). While it didn't grow as fast as Micron, Everex increased spending by nearly 200% to bring on-line two new production facilities. Everex and the other nine desktop computer companies surveyed posted the biggest average growth last year in capital spending, 38.4%. They were followed closely by the eight software companies, with average capital spending growth of 37.2%.

Capital spending as a percentage of net cash flow after dividends gauges a company's investment in its future. In 1989, the aggregate figure for the top 100 capital spenders stood at 98%, up significantly from 76% in 1988. However, anything less than 100% generally implies a capital base compromised for short-term profit. □

Diversified

IBM	$6,414.0	19.0%
NCR	421.0	0.2%
Honeywell	268.0	-18.2%
Harris	99.4	22.4%
Control Data	69.2	-59.2%
Varian Associates	49.0	13.3%
Total	**$7,320.5**	
Weighted average		**13.8%**

Government

Texas Instruments	$862.5	37.3%
GM Hughes Electronics	648.5	21.7%
Harris	99.4	22.4%
E-Systems	56.7	5.5%
SCI Systems	50.7	18.3%
Varian Associates	49.0	13.3%
Loral	40.5	-20.4%
M/A-COM	28.6	23.5%
Bolt Beranek and Newman	27.7	-3.7%
Watkins-Johnson	11.8	1.7%
Total	**$1,875.3**	
Weighted average		**25.3%**

Instruments & measurement

Hewlett-Packard	$857.0	32.3%
Honeywell	268.0	-18.2%
Tektronix	85.8	9.9%
Perkin-Elmer	56.6	-32.3%
Teradyne	28.3	42.8%
GenRad	15.3	23.6%
KLA Instruments	10.7	15.1%
Fluke	10.5	-33.0%
Total	**$1,332.2**	
Weighted average		**11.5%**

Mainframes

IBM	$6,414.0	19.0%
Unisys	615.4	-8.1%
NCR	421.0	0.2%
Amdahl	305.3	9.5%
Cray Research	99.2	20.9%
Control Data	69.2	-59.2%
Teradata	19.3	58.2%
Total	**$7,943.5**	
Weighted average		**13.1%**

Minicomputers

Digital Equipment	$1,223.0	-19.4%
Wang Laboratories	299.5	9.5%
Tandem Computers	136.0	-26.6%
Data General	91.5	-5.3%
Stratus Computer	37.0	107.6%
Concurrent Computer	12.7	-37.9%
Total	**$1,799.6**	
Weighted average		**-14.8%**

Desktop

Hewlett-Packard	$857.0	32.3%
Compaq Computer	367.6	34.4%
Apple Computer	239.0	66.0%
Sun Microsystems	204.8	74.5%
Intergraph	74.1	11.3%
Silicon Graphics	23.3	10.2%
Wyse Technology	18.3	-12.0%
Dell Computer	13.6	104.9%
Everex Systems	13.0	198.5%
AST Research	11.8	-18.7%
Total	**$1,822.6**	
Weighted average		**38.4%**

Peripherals

Seagate Technology	$78.1	-72.5%
Conner Peripherals	65.8	116.6%
Storage Technology	50.5	7.0%
Western Digital	38.9	8.6%
Applied Magnetics	38.8	-30.1%
Maxtor	29.2	-23.3%
Wyse Technology	18.3	-12.0%
Everex Systems	13.0	198.5%
Micropolis	12.8	-79.9%
Archive	12.6	112.5%
Dataproducts	11.7	59.1%
Total	**$369.9**	
Weighted average		**-37.7%**

Semiconductors

Motorola	$1,094.0	25.3%
Texas Instruments	862.5	37.3%
Intel	422.1	-11.6%
National Semiconductor	277.6	39.6%
Micron Technology	199.1	349.6%
Advanced Micro Devices	158.8	62.4%
LSI Logic	114.5	13.4%
Analog Devices	51.0	7.9%
VLSI Technology	39.5	-28.4%
Western Digital	38.9	8.6%
Cypress Semiconductor	32.9	-17.3%
Burr-Brown	28.0	31.6%
Integrated Device	26.6	-4.6%
Total	**$3,345.5**	
Weighted average		**26.4%**

Software

Microsoft	$89.4	24.7%
Oracle Systems	79.0	155.0%
Lotus Development	68.9	24.9%
Novell	43.2	182.0%
Mentor Graphics	39.2	33.8%
Computer Associates	22.4	19.0%
Ashton-Tate	22.3	-38.7%
Ultimate	9.4	-36.3%
Total	**$373.8**	
Weighted average		**37.2%**

Top U.S. capital spenders

Rank 1989	Rank 1988	Company	Total capital expenditures ($ millions)	Change from 1988	Capital expenditures as a percentage of revenue	Capital expenditures to net cash flow after dividends	Fiscal 1989 revenue ($ millions)	Fiscal year ended
1	1	IBM	$6,414.0	19.0%	10.2%	122.3%	$62,710.0	12/89
2	2	Digital Equipment	1,223.0	-19.4%	9.6%	69.5%	12,742.0	6/89
3	4	Motorola	1,094.0	25.3%	11.4%	104.3%	9,620.0	12/89
4	7	Texas Instruments	862.5	37.3%	13.2%	133.1%	6,521.9	12/89
5	6	Hewlett-Packard	857.0	32.3%	7.2%	71.1%	11,899.0	10/89
6	8	GM Hughes Electronics	648.5	21.7%	5.7%	77.9%	11,359.0	12/89
7	5	Unisys	615.4	-8.1%	6.1%	-166.3%	10,096.9	12/89
8	3	Xerox	436.0	-14.2%	3.5%	48.2%%	12,431.0	12/89
9	9	Intel	422.1	-11.6%	13.5%	67.2%	3,126.8	12/89
10	10	NCR	421.0	0.2%	7.1%	69.0%	5,956.0	12/89
11	16	Compaq Computer	367.6	34.4%	12.8%	88.0%	2,876.1	12/89
12	14	Amdahl	305.3	9.5%	14.5%	114.4%	2,101.1	12/89
13	12	Pitney Bowes	299.7	-3.2%	10.4%	102.3%	2,875.7	12/89
14	15	Wang Laboratories	299.5	9.5%	10.4%	-360.0%	2,868.8	6/89
15	19	National Semiconductor	277.6	39.6%	16.8%	-901.3%	1,647.9	5/89
16	11	Honeywell	268.0	-18.2%	4.4%	38.2%	6,058.6	12/89
17	18	AMP	252.1	14.5%	9.0%	75.7%	2,796.6	12/89
18	22	Apple Computer	239.0	66.0%	4.5%	45.2%	5,284.0	9/89
19	24	Sun Microsystems	204.8	74.5%	11.6%	125.1%	1,765.4	6/89
20	47	Micron Technology	199.1	349.6%	44.6%	137.8%	446.4	8/89
21	26	Advanced Micro Devices	158.8	62.4%	14.4%	92.3%	1,104.6	12/89
22	20	Tandem Computers	136.0	-26.6%	8.3%	58.9%	1,632.5	9/89
23	28	Tandy	122.5	30.1%	2.9%	35.5%	4,180.7	6/89
24	25	LSI Logic	114.5	13.4%	20.9%	166.4%	546.9	12/89
25	31	Harris	99.4	22.4%	4.5%	50.2%	2,213.6	6/89
26	30	Cray Research	99.2	20.9%	12.6%	51.9%	784.7	12/89
27	34	Molex	93.9	36.7%	16.4%	86.6%	571.9	6/89
28	27	Data General	91.5	-5.3%	7.0%	-503.0%	1,314.4	9/89
29	33	Microsoft	89.4	24.7%	11.1%	45.9%	803.5	6/89
30	32	Tektronix	85.8	9.9%	6.0%	111.2%	1,433.0	5/89
31	38	General Instrument	82.6	37.7%	6.3%	53.6%	1,304.7	2/89
32	57	Oracle Systems	79.0	155.0%	13.5%	75.3%	583.7	5/89
33	13	Seagate Technology	78.1	-72.5%	5.7%	91.6%	1,371.6	6/89
34	35	Intergraph	74.1	11.3%	8.6%	57.9%	860.1	12/89
35	21	Control Data	69.2	-59.2%	2.4%	-13.0%	2,934.5	12/89
36	40	Lotus Development	68.9	24.9%	12.4%	67.7%	556.0	12/89
37	58	Conner Peripherals	65.8	116.6%	9.3%	117.2%	704.9	12/89
38	42	E-Systems	56.7	5.5%	3.5%	53.5%	1,632.9	12/89
39	29	Perkin-Elmer	56.6	-32.3%	7.2%	125.2%	784.3	7/89
40	54	Medtronic	51.3	53.3%	6.9%	40.7%	741.7	4/89
41	44	Analog Devices	51.0	7.9%	11.3%	73.6%	453.4	10/89
42	49	SCI Systems	50.7	18.3%	5.1%	108.9%	986.8	6/89
43	—	Beckman Instruments	50.5	13.0%	6.4%	68.8%	785.9	12/89
44	46	DSC Communications	50.5	10.1%	11.8%	81.0%	429.7	12/89
45	45	Storage Technology	50.5	7.0%	5.1%	35.3%	982.5	12/89
46	48	Varian Associates	49.0	13.3%	3.6%	73.3%	1,343.6	9/89
47	80	Novell	43.2	182.0%	10.3%	68.2%	421.9	10/89
48	67	Applied Materials	42.9	116.7%	8.6%	67.9%	501.8	10/89
49	43	Loral	40.5	-20.4%	3.4%	37.3%	1,187.0	3/89
50	41	VLSI Technology	39.5	-28.4%	13.7%	101.4%	288.5	12/89

(Continued)

Top U.S. capital spenders

Rank 1989	Rank 1988	Company	Total capital expenditures ($ millions)	Change from 1988	Capital expenditures as a percentage of revenue	Capital expenditures to net cash flow after dividends	Fiscal 1989 revenue ($ millions)	Fiscal year ended
51	59	Mentor Graphics	$39.2	33.8%	10.3%	65.7%	$380.0	12/89
52	53	Western Digital	38.9	8.6%	3.9%	49.0%	992.1	6/89
53	39	Applied Magnetics	38.8	-30.1%	12.3%	191.4%	314.1	9/89
54	73	Stratus Computer	37.0	107.6%	10.8%	68.4%	341.3	12/89
55	55	Zenith Electronics	34.1	3.6%	2.2%	145.1%	1,548.9	12/89
56	—	Cypress Semiconductor	32.9	-17.3%	16.5%	58.2%	199.3	12/89
57	50	Maxtor	29.2	-23.3%	8.3%	130.2%	351.0	3/89
58	63	M/A-COM	28.6	23.5%	6.5%	117.8%	441.1	9/89
59	68	Teradyne	28.3	42.8%	5.8%	64.2%	483.6	12/89
60	64	Burr-Brown	28.0	31.6%	16.5%	141.7%	169.5	12/89
61	51	Sprague Technologies	27.7	-27.3%	8.0%	-48.8%	344.2	12/89
62	60	Bolt Beranek and Newman	27.7	-3.7%	9.5%	-355.1%	291.6	6/89
63	61	Integrated Device Technology	26.6	-4.6%	14.7%	71.7%	180.7	3/89
64	93	Measurex	25.0	143.6%	8.8%	70.8%	285.3	11/89
65	—	Vishay Intertechnology	23.8	68.4%	5.7%	59.4%	415.6	12/89
66	70	3Com	23.7	25.4%	6.1%	46.4%	385.9	5/89
67	—	Silicon Graphics	23.3	10.2%	8.8%	87.6%	263.8	6/89
68	62	Avnet	22.6	-8.5%	1.2%	34.3%	1,933.5	6/89
69	71	Computer Associates Int'l.	22.4	19.0%	2.2%	9.2%	1,030.2	3/89
70	52	Ashton-Tate	22.3	-38.7%	8.4%	357.6%	306.6	12/89
71	—	Teradata	19.3	58.2%	14.1%	103.3%	137.4	6/89
72	65	Wyse Technology	18.3	-12.0%	4.1%	-204.3%	452.3	3.89
73	75	Augat	18.0	1.9%	5.9%	74.1%	306.6	12/89
74	—	Smith Corona	17.9	102.2%	3.6%	36.1%	493.1	6/89
75	86	Andrew	16.3	26.7%	5.4%	53.2%	301.9	9/89
76	81	Dynatech	15.9	5.2%	4.0%	44.2%	399.5	3/89
77	69	Datapoint	15.8	-19.8%	5.0%	-154.0%	312.5	7/89
78	94	Scientific-Atlanta	15.6	54.1%	2.9%	33.5%	546.8	6/89
79	87	GenRad	15.3	23.6%	8.1%	148.2%	188.9	12/89
80	—	Tellabs	14.3	29.4%	7.9%	100.0%	181.3	12/89
81	—	Symbol Technologies	14.1	-7.4%	6.3%	54.1%	222.3	12/89
82	90	Westmark International	14.0	24.5%	3.2%	45.5%	438.8	12/89
83	—	Dell Computer	13.6	104.9%	4.0%	123.9%	338.6	1/90
84	—	Everex Systems	13.0	198.5%	3.5%	47.8%	377.3	7/89
85	36	Micropolis	12.8	-79.9%	4.2%	-47.8%	307.3	12/89
86	66	Concurrent Computer	12.7	-37.9%	4.6%	174.9%	278.0	6/89
87	—	Archive	12.6	112.5%	7.0%	59.7%	181.4	9/89
88	82	AST Research	11.8	-18.7%	2.6%	305.2%	456.5	6/89
89	89	Watkins-Johnson	11.8	1.7%	3.8%	45.0%	310.7	12/89
90	—	Dataproducts	11.7	59.1%	3.3%	87.5%	353.4	3/89
91	—	Intermec	11.7	197.6%	8.9%	92.1%	131.1	3/89
92	95	CTS	10.8	8.4%	4.1%	44.7%	262.0	12/89
93	—	KLA Instruments	10.7	15.1%	6.5%	59.1%	165.5	6/89
94	78	Fluke	10.5	-33.0%	4.2%	32.1%	247.7	9/89
95	79	Gerber Scientific	10.3	-33.3%	3.4%	26.2%	299.3	4/89
96	—	Diebold	9.9	21.5%	2.1%	33.5%	468.9	12/89
97	84	ADC Telecommunications	9.6	-28.9%	4.9%	35.4%	196.4	10/89
98	—	Network Equipment Technologies	9.4	100.1%	6.9%	38.0%	136.7	3/89
99	—	Ultimate	9.4	-36.3%	4.7%	-174.6%	199.9	4/89
100	92	Diasonics	9.3	-11.4%	4.8%	-62.4%	194.2	12/89

Auto electronics companies find safety net for sales

Increasing use of safety devices such as anti-lock braking systems and air bags is driving strong growth for automotive electronics makers

BY GIUSEPPE LABIANCA

Step into a car showroom, and you'll see consumers buying automobiles loaded with safety features. Carmakers are racing to incorporate anti-lock brakes and air bags throughout their product lines. So automotive electronics makers can smile because increasing electronic content is beginning to offset a soft car market.

North American automobile sales are currently mired in a slump, with sales expected to fall from 14.9 million units in 1989 to 14.3 million units in 1990, according to Morgan Stanley and Co. Investment Research in New York City. But Morgan Stanley analysts are projecting an increase in sales beginning in 1991, with sales reaching 17.9 million units by 1994. The expected increased car production, plus greater electronic content, will push the automotive electronics market along at an 8% annual growth rate for the next five years, notes Paul Hansen, president of Hansen Associates, a Goffstown, N.H., market research firm.

According to a recent study by another research group, The Freedonia Group Inc. of Cleveland, original equipment maker (OEM) electronic content of North American light vehicles will increase from $515 per vehicle in 1989 to $1,100 per vehicle in 1994.

Safety and security represent the fastest-growing category in automotive electronics, according to the Freedonia Group study. That category includes anti-lock braking systems (ABS), air bags and other electronic passenger restraints, anti-theft systems and traction control. The Freedonia Group forecasts annual growth of nearly 45% in the safety and security category between 1989 and 1994, more than double the bullish 19% growth rate that Freedonia forecasts for the total automotive electronics market in North America.

TRW Inc. estimates that the North American market for air bags alone will grow from $360 million in 1989 to $2.3 billion by 1994. TRW, which claims to be the largest supplier of air bag systems, has dedicated an entire division to the production of occupant restraints. This division, which also produces motorized seat belts, is TRW's fastest-growing business, with 1989 sales of $817 million projected to rise to more than $2 billion by 1994.

According to Dataquest Inc., a San Jose market research firm, the OEM installation rate of air bags will increase from near zero in the 1988 model year to 63% of North American vehicles by the 1995 model year. The driving force behind the rapid growth is a federal regulation requiring passive restraints on all automobiles sold beginning with the 1990 model year.

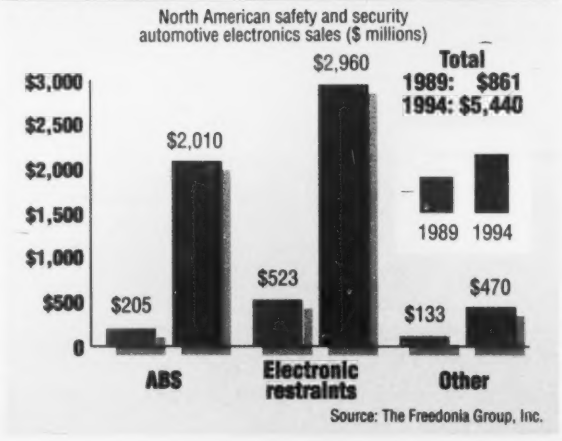
Passive electronic seat belt systems, a substitute for air bags in some automobiles, will be installed in 27% of the vehicles by model year 1995, up from 2.2% in 1988, says Dataquest. Customers prefer the unobtrusive air bags to passive belt systems, however, say Freedonia Group analysts, so it is expected that these belt systems will remain popular only until air bags are installed universally.

Although air bags are proliferating due to federal legislation, competitive pressures between the automakers themselves are pushing installation of anti-lock braking systems. "Automotive Electronics Delphi V," a report published by the University of Michigan's Office for the Study of Automotive Transportation, projects that 40% of North American passenger vehicles will have anti-lock braking systems by 1995. Dataquest is even more bullish on ABS — analysts there see ABS installations by OEMs increasing from a 3.3% rate in the 1988 model year to 70% in 1995.

A leading independent European supplier of ABS, German manufacturer Robert Bosch GmbH, is adding ABS production facilities in its South Carolina-based U.S. headquarters to meet the growing need for passenger car ABS systems in North America.

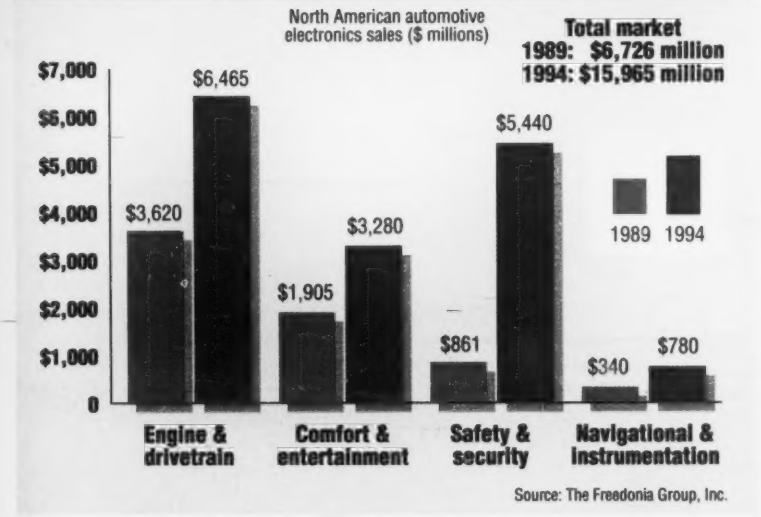
Unlike the systems suppliers, U.S. automotive semiconductor suppliers

The safety and security segment



Source: The Freedonia Group, Inc.

The North American automotive electronics market



The safety and security segment will make up 34% of the total 1994 North American automotive electronics market, up from 13% in 1989

are expecting flat sales this year. According to the Semiconductor Industry Association, the worldwide automotive semiconductor market will be $2.4 billion in 1990, down slightly from $2.5 billion in 1989. A representative for Texas Instruments Inc., a leading automotive microcontroller supplier, says, "We see things remaining flat for the rest of this year because of slow auto sales. But electronic content continues growing at a faster pace, which is very encouraging for us in the long term." The SIA is projecting strong growth over the next three years, with automotive semiconductor sales reaching $3.8 billion by 1993.

Intel Corp.'s automotive division is waiting eagerly for the ABS explosion. Fred Phail, strategic marketing manager for Intel's automotive division in Chandler, Ariz., says Intel's automotive semiconductor sales will be flat for the year, thanks to the auto sales downturn. But Phail says he expects that the increased use of ABS systems in passenger vehicles will help increase sales in 1991 and 1992. Intel introduced seven new 16-bit microcontrollers in March that specifically target the ABS market.

National Semiconductor is the leading microcontroller supplier for ABS systems because of its hold on ABS for trucks, says Michael Caldwell, National's microcontroller marketing manager in Santa Clara, Calif. But Intel's Phail notes that ABS has already achieved 90% penetration on trucks due to legislation, so there is not much room for further growth.

The hot growth area for automotive semiconductor makers is Europe, notes Intel's Phail. The increasingly tight emission standards in Europe mean more sophisticated engine control systems will be required there. Automobile production is also growing more rapidly there than in North America. And with the opening of Eastern Europe, the need for pollution-reducing engine control systems will provide growth opportunities for semiconductor manufacturers. Delco Electronics Corp., General Motors Corp.'s captive electronics supplier, recently announced a plan to double production of engine control modules in Europe over the next 18 months.

Europe is the hot growth area for automotive semiconductor makers

In 1994, the largest segment of North American automotive electronics will remain the engine and drive train controls, although their percentage of the total automotive electronics market will drop to 40% from 54% in 1989, according to the Freedonia Group study. The reason for the declining growth is that engine controls are nearly universal already, due to federal emissions legislation. Motorola Inc. and Intel are the chief microcontroller suppliers in this field: Motorola supplies GM and Chrysler Corp.; Intel supplies Ford Motor Co.

The largest producers of automotive electronics systems in North America include the captive suppliers to GM, Ford and Chrysler. According to analyst Hansen, the only one of the three that is experiencing strong growth is Ford Electronics. It is growing at a 15% pace, Hansen says, because it has not been losing as much share of the world market as have Chrysler and GM. That, he says, is because of Ford's strength in Europe.

Delco saw revenues edge up to $4.0 billion in 1989 from $3.8 billion a year ago, this despite a fall in North American vehicle sales for GM. Flat sales projections for the North American market have sent captive suppliers scrambling to increase their outside sales. International sales and outside domestic sales of automotive products at Delco reached $264 million in 1989, a 20% increase over 1988. By 1995, non-GM sales are projected to reach $600 million.

Hansen says Chrysler's Acustar Inc. division logged electronics sales of about $600 million last year, flat from the previous year. John B. Monaghan, director of customer relations at Acustar, says that 90% of its sales are dependent on Chrysler, but he declined to give revenue figures.

"Right now, automotives make up virtually 100% of our business," he says. "But we are pursuing business outside of automotives such as the medical equipment market and the consumer market for things like computerized exercise equipment." With only 2% of its sales going to foreign manufacturers, Acustar hopes to increase its foreign sales through a strategic alliance with Philips AG. □

Boom days are ahead for programmable logic

Looking for the next hot semiconductor market? Forget SRAMs, high-speed DRAMs or MPUs; surging demand for PLDs is catching the interest of the biggest players

BY TERI SPRACKLAND

Logic has been the overlooked factor in the electronics equation. DRAM shortages keep memory components highly visible. Microprocessors make for big-splash introductions. But logic — ho hum.

Not any more. Some of the hottest companies are in the programmable logic market. The success of Xilinx as it went public with strong valuations earlier this year has the industry taking notice. Lattice Semiconductor is getting respect after rebounding from bankruptcy to excellent profitability. Privately held Actel Corp. recently received funding from Hewlett-Packard.

Market analysts and industry participants agree that boom days are ahead in programmable logic. There's uncertainty, though, about what will happen once the CMOS user-programmable portion of the market reaches its potentially $1 billion size. The smaller companies now flourishing may need to either grow substantially or make strategic alliances to survive the influx of bigger players.

While there's room for innovators, very strong patents in basic technology have fenced out giant Asian competitors and helped keep most of the PLD market profitable. In April, for instance, Samsung conceded defeat in the PLD market by settling out of court a patent suit brought by Advanced Micro Devices Inc.

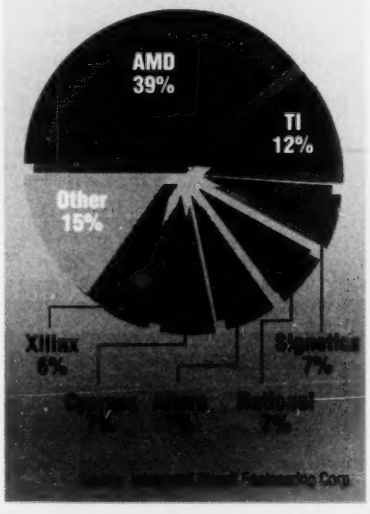
Programmable logic is moving rapidly towards greater complexity and speed. The pressure to get new products out the door and to market through shorter windows of opportunity has customers shelling out for costlier, more complex parts. Applications that use very fast microprocessors need faster, although not necessarily more complex, PLDs.

For manufacturers of high-speed PCs, peripherals and workstations, the demand is for high-speed, low-cost devices. The current frontier is 5 nanoseconds in TTL, with ECL offerings as fast as 2 nanoseconds. Bipolar devices are faster than those based on newer CMOS technology. Dominating the bulk of sales volume are the giant chipmakers: AMD, Texas Instruments, National Semiconductor and Signetics.

Coming up fast, although always a step behind in speed, are CMOS PLDs. The bipolar houses have moved with varying degrees of eagerness to embrace CMOS. The company that could be considered nearly synonymous with the PLD market has been AMD, which acquired a dominant position in bipolar after its 1987 merger with Monolithic Memeories Inc. (MMI). According to market research firm Integrated Circuit Engineering Corp., AMD has more than three times the PLD sales of its nearest competitor, Texas Instruments. ICE estimates AMD's total 1989 PLD sales at $285 million, of which $262 million was bipolar and $23 million CMOS.

AMD's commanding lead

1989 PLD Market Share = $740 million



In 1990, when total PLD sales rise from $740 million to $850 million, CMOS sales will claim 52% of the market, predicts ICE. CMOS PLDs are projected to have a cumulative average growth rate of 33% from 1989 through 1994, compared with a 7% drop in bipolar sales. Only the need for speed will prevent customers from defecting to CMOS, notes ICE.

However, the major bipolar houses were estimated by ICE to be losing ground in total PLD sales as the value of their bipolar sales dropped in the last two years. AMD's estimated 1989 sales dips from the 1988 total sales of $306 million, of which $297 million was bipolar. After a slow start in CMOS, AMD is working hard to introduce CMOS products.

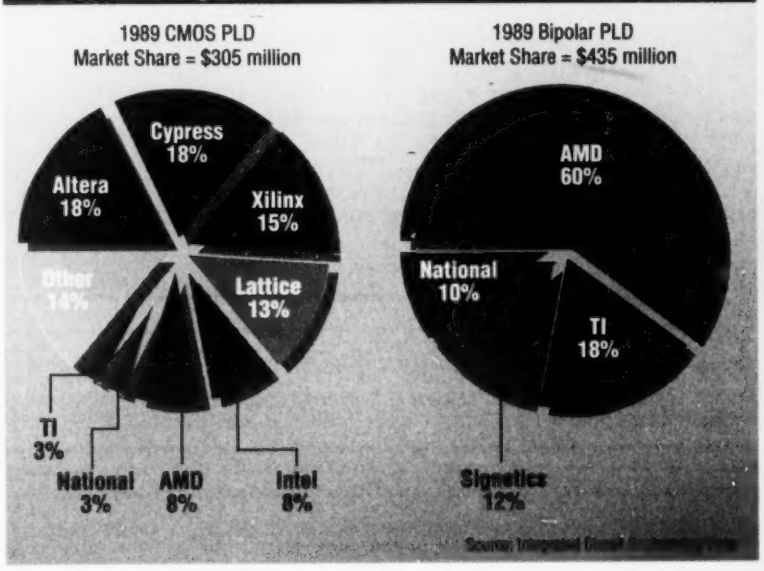
At AMD, Andy Robin, director of marketing for programmable logic, believes that customer interest in 5-nanosecond parts is heating up for use in faster microprocessors. "At 40 or 50 megahertz, 71/2 nanoseconds is not quite fast enough," Robin says. "In bipolar, it's speed, speed, speed that counts." In CMOS, AMD is ramping up production to a million units a quarter, and sees major accounts now adopting CMOS parts. But AMD is no longer attempting to make field-programmable gate arrays (FPGAs) as a second source to Xilinx. "There's no question that Xilinx is doing great, and we are happy to own one-fifth of the company. It's a huge opportunity and we are sharing in the profits through our invest-

ment. They're going to hit $90 million this year," Robin says.

Cyrus Tsui, now president and chief executive officer at CMOS vendor Lattice Semiconductor Corp. and a longtime AMD veteran, sees Portland, Ore.,-based Lattice's short-term strategy as "cannabilizing bipolar sockets. CMOS is not super high-volume business," he said, "but it generates higher margins. But by 1992 at the latest, CMOS will be the dominant technology in the PLD marketplace."

At Atmel Corp. in San Jose, Calif., the fastest growth has been in designs of midrange complexity, according to Jeffrey Katz, vice president of marketing. "We're tripling run rates every quarter," he says. The midrange designs are attractive for engineers that might find the design task for FPGAs just too overwhelming, he says. "It's easier to bite off and chew on several midrange designs. That's easier to comprehend than something that can be the size of a small gate array."

CMOS vs. Bipolar: New faces vs. established leaders



No standard in sight

Dan Mahoney, programmable logic marketing manager for Cypress Semiconductor, defines his company's strategy as one of providing enhanced performance CMOS or BiCMOS versions of existing parts. "Speed is driving the new business, offsetting to some extent the decline of slower parts," Mahoney said. "Average selling prices and unit volumes [of older parts] are declining, but not precipitously." The more complex parts lack industry standard versions and aren't likely to evolve into standard parts, given divergences in architecture to meet different application needs. "The future is not five or six companies waging a price war, like in the past. It will be 10 or 12 companies fighting for the hearts and minds of designers."

However, others, such as Signetics, see the landscape differently, and claim that the demand for high-speed devices from the burgeoning workstation market has kept bipolar PLDs profitable. BiCMOS is a hot field for logic devices, such as a new bus-interface logic family jointly introduced in June by Signetics and Texas Instruments, says Don Phillips, strategic marketing manager for programmable logic at Signetics.

At the top of the pyramid are devices that are not quite gate arrays but more than PLDs. After some years of hesitation, the industry seems to be settling on the term "field programmable gate arrays" to describe these devices.

Technology advantages of various approaches, whether static RAM-based, antifuse or electrically erasable, are hotly disputed, and even the methods of measuring gate complexity differ by vendor. Also a factor here is the need for engineers who use these devices to buy proprietary design systems.

The name of the game is helping customers get to market faster and with less risk

The name of the game is helping customers get to market faster and with less risk. Programming done by the customer bypasses the non-recoverable engineering costs and the weeks or months needed to design and make gate arrays. The risk of a loss associated with a redesign is minimized. But FPGAs are more expensive per unit for large quantities.

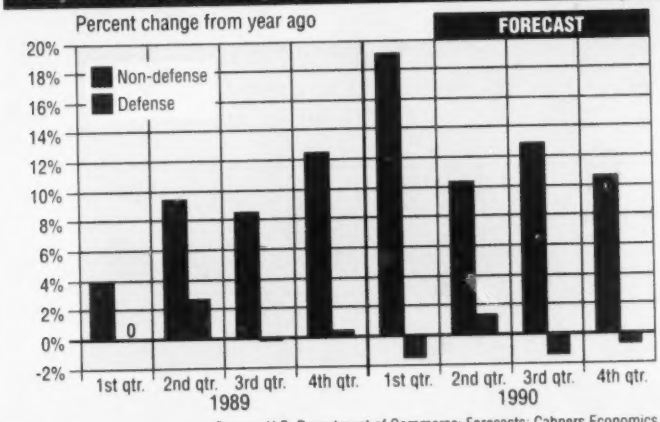
Wes Patterson, chief operating officer at Xilinx, sees a diversified market for FPGAs. In its last fiscal year, Xilinx made 38% of its revenues on sales to computer applications, 36% to telecommunications, 18% to industrial control and 8% to military applications from a customer base of 3,000 users.

Also working the FPGA market is The Plessey Co., which has introduced a device with an SRAM-based technology similar to Xilinx. Plessey recently was acquired in a prolonged hostile takeover, and its semiconductor operations are now controlled by GEC of Great Britian.

According to John East, president and CEO of Actel Corp. in Sunnyvale, Calif., orders are pouring in over the transom. "Everybody is using FPGAs. Since neither we nor our competitor Xilinx have our own fab, it's a good example of fabless business," he says. "The volume of sales is pandemonium in the making." Patent protection will be a crucial competitive issue, East adds. Actel has 36 patents on its process.

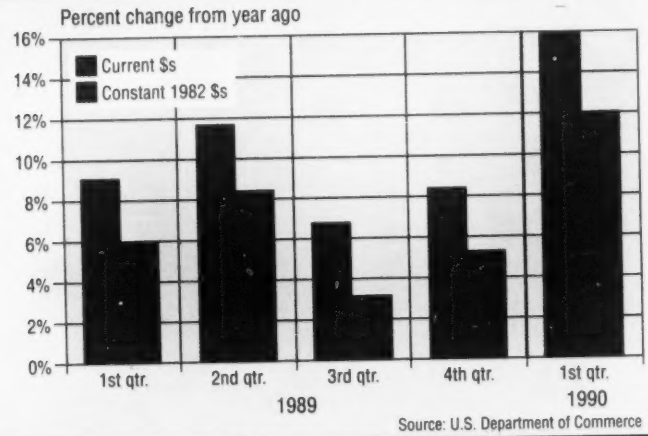
"It's a question of how fast we can grow the market, because market demand is many times higher than capacity," notes Andy Haines, Actel's marketing manager. Actel expects to introduce a new family of products in August. □

Communication equipment shipments



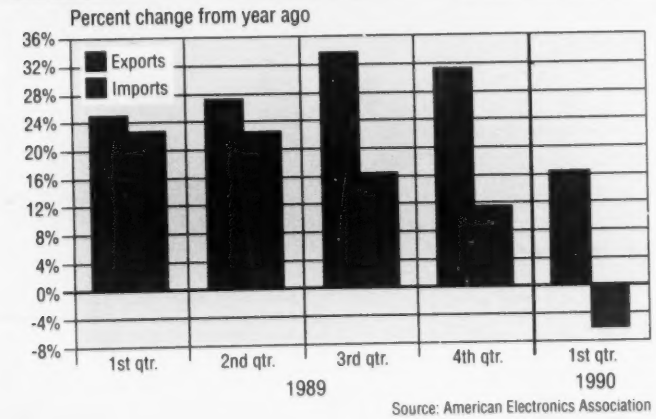
Source: U.S. Department of Commerce; Forecasts: Cahners Economics

U.S. purchases of communications equipment



Source: U.S. Department of Commerce

U.S. trade in telecommunications equipment



Source: American Electronics Association

Commercial sector fuels communications growth

During the first quarter of 1990, U.S. shipments of communications equipment grew by 9.5% from year-ago levels to $20.3 billion. With the defense communication equipment sector facing no-growth prospects, the commercial sector is driving the industry's growth. Shipments of non-defense communications equipment skyrocketed 19% in the first three months of this year compared to the same quarter last year, while first-quarter defense communications equipment shipments decline 1.5% from 1989 to 1990.

Because new orders for telecommunications and data communications equipment are climbing at double-digit rates, expect shipments to continue their steady advance. Despite the overall economic weakness, Cahners Economists is forecasting telecommunications shipments to increase by 13% in 1990 and by 8.5% in 1991.

The sanguine expectations are based on healthy business investment in communications equipment. In the first quarter of this year, U.S. purchases of communications equipment swelled 15.8% from year-ago levels to an annualized $52.8 billion. That is the largest year-over-year gain since the first quarter of 1985. Even adjusted for inflation, U.S. businesses increased their purchases of communications equipment by 12% in the first quarter of 1990.

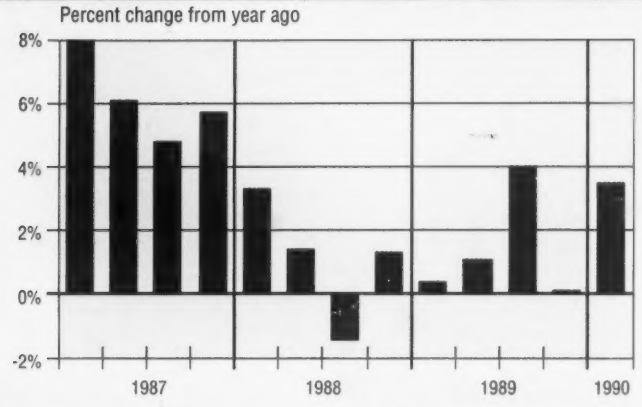
Cahners Economics anticipates communications purchases to remain strong at least through the end of 1992 as communications investment hits an inflation-adjusted growth rate of 10% this year and 6.5% in 1991. Look for strong activity in telecommunications equipment, local area networks and facsimile machines to lead the way.

Exports are another reason for a relatively optimistic outlook. Although the trade-weighted U.S. dollar has rebounded from its most recent 1988 low, exports are still growing. U.S. exports of telecom equipment jumped by 16.3% in the first quarter of 1990 from a year ago to $1.41 billion, according to the American Electronics Association. Imports of such equipment dropped 6.3% to $1.85 billion.

U.S. trade in telecommunications equipment with Japan improved markedly earlier this year, in part because of trade talks between Japan and the U.S. From first quarter 1989 to the first quarter 1990, exports surged 48.9% to $134 million. By contrast, telecommunications imports from Japan plunged 19.3% to $811 million in the first three months of the year.

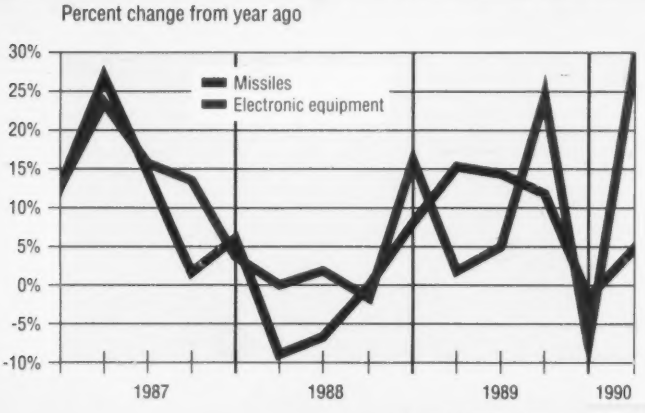
MADELINE FRANCHI

U.S. defense purchases: Total...



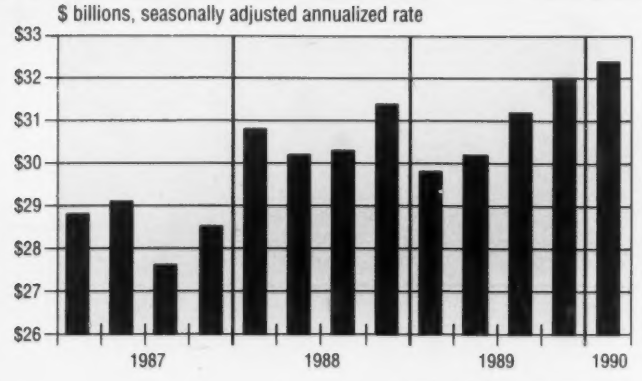
Source: Bureau of Economic Analysis

...Missiles and electronic equipment



Source: Bureau of Economic Analysis

...Contractual R&D



Source: U.S. Commerce Department, Bureau of Economic Analysis

Some defense sectors show strong gains

National defense purchases rose by 3.5% in the first quarter of 1990 from year-ago levels to an annualized $309 billion. Adjusted for inflation, however, the gain was a meager 0.6%. Cutbacks in defense spending hit platform makers the hardest as the federal government bought fewer aircraft and vehicles. On the other hand, purchases of missiles, electronic equipment and contractual research and development services all posted gains in the first quarter.

In particular, first-quarter data shows that Pentagon purchases of missiles inched up to an annualized rate of $13.5 billion, a 4.7% increase above the first quarter of 1989. However, when measured in constant 1982 dollars, purchases of missiles swelled 9% in the first quarter of 1990, compared to the same period last year. Missile purchases for all of 1989 showed a 9.7% gain over the previous year.

Defense Department purchases of electronic equipment saw strong gains rising 28.8% in the first quarter of 1990 to an annualized $7.6 billion, compared to the same quarter in the prior year. Growth in purchases of electronic equipment has held up despite cuts in overall defense spending. On average, defense electronics will fare better than most defense sectors because of the need to integrate new technology into existing platforms.

Recent evidence points to growing defense expenditures for contractual research and development services in the first quarter of this year. First-quarter national defense purchases of contractual research and development services rose 8.7% above year-ago levels to a seasonally adjusted annual rate of $32.4 billion. After adjusting for inflation, defense purchases of contractual R&D climbed to $25.9 billion in the first quarter of this year, a 6.2% rise above the first quarter 1989 level.

What is the outlook for research and development now that the defense budget is shrinking? According to the Electronic Industries Association, the budget for research, development, test and evaluation (RDT&E) will decline from $39.3 billion in 1988 to $28.8 billion in 1999 (measured in constant 1990 fiscal-year dollars). However, in 1988 $18 billion was spent on the electronic content of RDT&E. By the end of 1999, the EIA estimates that $13.5 billion will be spent on the electronic content of RDT&E.

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